

# Analysis on Fundamental Factors affecting Fuel Economy of Light Duty Vehicles

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## Abstract

Fuel economy is one of the two major performance indicators of a vehicle whereas the other key indicator is the emission of mass pollutants. Recent policy related initiatives that have taken in place in vehicle manufacturing countries/regions viz. EU, USA, and Japan depict that a strict attention has been paid to control the fuel economy of the newly manufactured vehicles, especially light duty vehicles (LDVs). In order that, obtaining a better level of understanding on the fundamental factors affecting the fuel economy of vehicles is significant. Goal 7 of the Sustainable Development Goals (SDGs) aims to ensure sustainability and accessibility of energy and as a part of it, target 7.3 aims to double the global rate of energy efficiency, which includes the improvements in vehicle fuel economy. Also Goal 13 of SDGs aims to take urgent action to combat climate change and its impacts. Since transport sector is accountable for almost a quarter of CO<sub>2</sub> emissions, the improved fuel economy can help reduce it.

Factors affecting the fuel economy of LDVs can initially be categorized into 2 main types i.e. vehicular factors and non-vehicular factors. Non-vehicular factors can secondarily be categorized into 5 main types i.e. weather-related factors, traffic related factors, Street environment related factors, Travel behavior related factors and Driver behavior related factors. Vehicular factors can secondarily be categorized into 2 types i.e. Static vehicular factors and Dynamic vehicular factors. Static vehicular factors can be defined as the vehicular characteristics that do not vary in the temporal domain whereas the Dynamic vehicular factors can be defined as vice-versa.

During the analysis, the Static vehicular factors affecting the fuel economy can again be listed into 4 sub-categories as mentioned below.

### Static Vehicular Factors

- Power Generation related
- Power Transmission related
- Traction related
- Other Static Factors

The sub-factors that can be listed under power generation factors are engine configuration, type of energy/fuel used, number of cylinders, cylinder capacity, type of ignition, firing order,

engine valve configuration, camshaft configuration, method of fuel injection, compression ratio, power-boosting mechanisms and engine placement.

The sub-factors under the power transmission can be listed as type of transmission, speed ratio configuration, gear-changing mechanisms used and etc. The traction related sub-factors can be listed as type of driving-wheels (i.e. front-wheel drive/rear-wheel driver or all-wheel drive), wheel factors (i.e. size and weight of the wheel, without the tyre), tyre-related factors and brakes-related factors. The other static vehicular factors affecting the fuel economy can be mentioned as vehicular body dynamics and vehicular weight(no-load). The Dynamic vehicular factors can be listed as kinetics related factors (viz. torque, friction, drag, etc.), kinematics related factors (viz. velocity, acceleration etc.) and vehicular maintenance related factors (viz. vehicle-aging, vehicle-mileage, service routines, etc.).

Identifying and classifying the fundamental factors affecting fuel economy is primarily significant whereas developing functional relationships between fuel economy and fundamental factors will be performed secondarily. Governing equation(s) for fuel economy will be developed subsequently. Hence, the respective analysis is performed in order to explicitly identify the fundamental factors which affect the fuel economy of LDVs.

**Keywords:** Fuel Economy, Light Duty Vehicles, Fundamental Factors, Static Factors, Dynamic Factors, Sustainable Development Goals.

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